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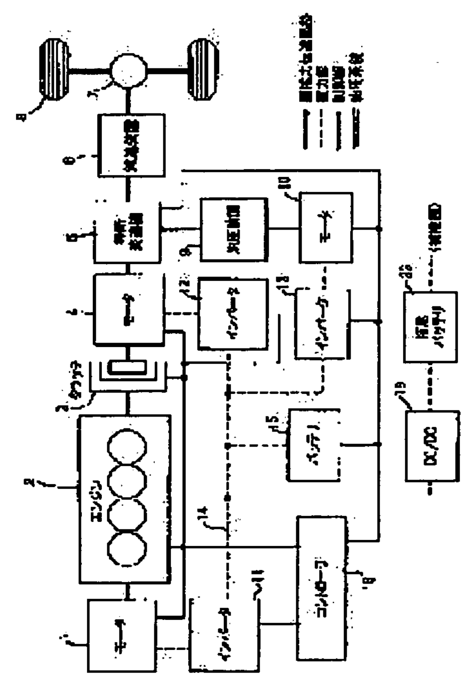
(71)Applicant : NISSAN MOTOR CO LTD

(72)Inventor : KOMIYAMA SUSUMU
OKURA KAZUMA
ARIMITSU MINORU
SHOJI ATSUSHI

(54) CONTROLLER FOR HYBRID VEHICLE

(57)Abstract:



PROBLEM TO BE SOLVED: To properly control charging and discharging power of a heavy current battery for supplying power to the drive motor of a hybrid vehicle.

SOLUTION: In a hybrid vehicle provided with an engine 2 and a first motor 4, which are able to transmit drive force to the drive systems of a vehicle respectively, a second motor 1 for starting the engine 2, a heavy current battery 15 for supplying power to each motor, a dc-to-dc converter 19 for regulating the output of this battery 15 to a voltage which fits the electric system of the vehicle, and a controller 16 for controlling the quantities of power to be supplied to each motor and the dc-to-dc converter 19 from the battery 15 according to the operating condition of the vehicle, constitution is so made that power of the battery 15 is distributed preferentially in the order of consumed power according to the outputtable power of the battery 15, when the outputtable power of the battery 15 is smaller than the sum of the power consumed by the dc-to-dc converter 19, power consumed by the second motor when the second motor starts, and power consumed by a first motor, when its motor running is performed.

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CLAIMS

[Claim(s)]
[Claim 1] The engine and the 1st dynamo-electric machine which can transmit driving force to the drive network of a car, respectively, The 2nd dynamo-electric machine which puts said engine into operation, and the heavy current dc-battery which supplies power to said each dynamo-electric machine, The DC to DC converter which adjusts the output of this heavy current dc-battery to the electrical potential difference which suits the electric system of a car, In the hybrid car equipped with the control circuit which controls the amount of supply voltages from said heavy current dc-battery to each dynamo-electric machine and a DC to DC converter according to the operational status of a car Said control circuit is responded to the output possible power of a heavy current dc-battery. The output possible power concerned The control unit of the hybrid car constituted so that the power of a heavy current dc-battery might be preferentially supplied in order of said power consumption at the time of the power running of power consumption and the 1st dynamo-electric machine at the time of the power consumption of a DC to DC converter, and starting of the 2nd dynamo-electric machine, when smaller than total with power consumption.
[Claim 2] A hybrid car is the control unit of the hybrid car according to claim 1 characterized by constituting so that a control circuit may give priority to the power consumption of this 3rd dynamo-electric machine over power consumption at least at the time of the power running of the 1st dynamo-electric machine and may supply it, while having the 3rd dynamo-electric machine which supplies power required for actuation of a change gear.
[Claim 3] A control circuit is the control unit of the hybrid car according to claim 2 characterized by the output possible power of the heavy current dc-battery at the time of engine starting constituting so that the drive of the 3rd dynamo-electric machine may be forbidden until engine starting is completed at the time of the power consumption of a DC to DC converter, and starting of the 2nd dynamo-electric machine, when smaller than total with power consumption and the power consumption of the 3rd dynamo-electric machine.
[Claim 4] A control circuit is the control unit of the hybrid car according to claim 1 characterized by having driven the 2nd dynamo-electric machine with the engine, and constituting so that power may be generated when the output possible power of a heavy current dc-battery is insufficient in the operational status from which transit driving force is obtained only by the 1st dynamo-electric machine.
[Claim 5] A control circuit is the control unit of the hybrid car according to claim 4 characterized by constituting so that the generating power by the 2nd dynamo-electric machine may be supplied to the 1st dynamo-electric machine.
[Claim 6] The 1st dynamo-electric machine which performs a regeneration generation of electrical energy based on the turning effort from a car drive network at the time of moderation of a car or braking while transmitting driving force to the drive network of a car based on the power from a heavy current dc-battery, 2nd at least one dynamo-electric machine which generates electricity based on an engine output, In the hybrid car equipped with the control circuit which controls the regeneration generation of electrical energy by said 1st dynamo-electric machine, and the generation of electrical energy by the 2nd dynamo-electric machine according to the operational status of a car Said control circuit is responded to the power of a heavy current dc-battery which can be charged. The power concerned which can be charged The control unit of the hybrid car constituted so that a

heavy current dc-battery might be preferentially charged in order of said power, when smaller than total with the regeneration generated output at the time of moderation by the 1st dynamo-electric machine, the regeneration generated output at the time of braking by the 1st dynamo-electric machine, and the generated output by the 2nd dynamo-electric machine.
[Claim 7] The control unit of the hybrid car according to claim 6 characterized by including the power always consumed in a car in the power of a heavy current dc-battery which can be charged.

[Translation done.]

* NOTICES *

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the control unit of the hybrid car equipped with the engine and the dynamo-electric machine as a source of power of a car.
[0002]
[Description of the Prior Art] It has simulataneously an engine and a motor (dynamo-electric machine which serves both as a motor and a generator) as a source of power of a car, and the hybrid car it was made to run with the driving force of either or both sides is known (for example, railroad Japan issue "automotive engineering" VOL.46 No.7 1997 year 6 month number refer to 39 - 52 pages).
[0003] By such hybrid car of the so-called parallel method, fundamental comparatively, if it runs only by the motor and a load increases, an engine will be started, necessary driving force will be secured and the maximum driving force will be demonstrated by using a motor and an engine together if needed in the small operation region of a load. Moreover, at the time of car moderation, regeneration operation which operates a motor as a generator is performed, and moderation energy is used for dc-battery charge.
[0004] By the way, by such hybrid car, while running the motor as a driving source, the discharge condition of a dc-battery is always supervised so that the dc-battery which is a power source may not serve as overdischarge, a generator is driven with an engine if needed, and it is made to perform dc-battery charge. However, in the conventional thing, since only the existence of dc-battery capacity mainly required for the transit (power running) by the motor was supervised, lack was produced in dc-battery capacity to the power used by the whole car, and there was a possibility of causing trouble to operation of a car depending on the case.
[0005] That is, the comparatively low-pressure power for driving auxiliary machinery other than the comparatively high-pressure power for motorised, such as an engine ignition, and a fuel injection equipment, a lighting system of a car, is required of a hybrid car. For this reason, it becomes the configuration different from the heavy current dc-battery for motorised which supplies the power for auxiliary machinery, or the charge power to an auxiliary dc-battery from a heavy current dc-battery through a DC to DC converter while forming the auxiliary dc-battery of low-power output comparatively. Here, the situation where only the minimum power required for motorised is left behind when control of electric power of a heavy current dc-battery is being carried out only on the basis of the dc-battery capacity for motorised for transit arises, and in this condition, when motorised is actually made, dc-battery capacity declines even near a limitation at that time, and the problem that the supply voltage of a DC to DC converter and auxiliary machinery will be insufficient arises.
[0006] Moreover, by the hybrid car, since an engine repeats starting and a halt if needed, if it is relatively insufficient for it as it is necessary to also always secure power required for actuation of the engine motor for starting and the capacity of a heavy current dc-battery mentioned it above temporarily, it produces a possibility that engine startability may get worse and is not desirable.
[0007] If regeneration operation is performed too much in the condition that sufficient power for a heavy current dc-battery is conserved on the other hand, since it will become the excess of charge and the faults [exhausting / a dc-battery] will arise, it is necessary to manage appropriately based on the power demand of the whole car not only about discharge of a dc-battery but about charge.

[0008] This invention was not made paying attention to such a trouble, and is aimed at managing appropriately the charge-and-discharge power of a heavy current dc-battery so that trouble may not be produced in operation of a hybrid car.
[0009]
[Means for Solving the Problem] Invention of claim 1 The engine and the 1st dynamo-electric machine which can transmit driving force to the drive network of a car, respectively, The 2nd dynamo-electric machine which puts said engine into operation, and the heavy current dc-battery which supplies power to said each dynamo-electric machine, The DC to DC converter which adjusts the output of this heavy current dc-battery to the electrical potential difference which suits the electric system of a car, In the hybrid car equipped with the control circuit which controls the amount of supply voltages from said heavy current dc-battery to each dynamo-electric machine and a DC to DC converter according to the operational status of a car Said control circuit is responded to the output possible power of a heavy current dc-battery. The output possible power concerned At the time of the power consumption of a DC to DC converter, and starting of the 2nd dynamo-electric machine, at the time of the power running of power consumption and the 1st dynamo-electric machine, when smaller than total with power consumption, it constituted so that the power of a heavy current dc-battery might be preferentially supplied in order of said power consumption.
[0010] In invention of above-mentioned claim 1, invention of claim 2 constituted the control circuit so that priority might be given to the power consumption of this 3rd dynamo-electric machine over power consumption at least at the time of the power running of the 1st dynamo-electric machine and it might be supplied, while being equipped with the 3rd dynamo-electric machine which supplies power required for actuation of a change gear.
[0011] The output possible power of the heavy current dc-battery at the time of engine starting constituted invention of claim 3 so that the drive of the 3rd dynamo-electric machine might be forbidden until engine starting completes the control circuit of invention of above-mentioned claim 2 at the time of the power consumption of a DC to DC converter, and starting of the 2nd dynamo-electric machine, when smaller than total with power consumption and the power consumption of the 3rd dynamo-electric machine.
[0012] When the output possible power of a heavy current dc-battery was insufficient in the control circuit of invention of above-mentioned claim 1 in the operational status from which transit driving force is obtained only by the 1st dynamo-electric machine, invention of claim 4 drove the 2nd dynamo-electric machine with the engine, and it constituted it so that power might be generated.
[0013] Invention of claim 5 was constituted so that the generating power according the control circuit of invention of above-mentioned claim 4 to the 2nd dynamo-electric machine might be supplied to the 1st dynamo-electric machine.
[0014] The 1st dynamo-electric machine which performs a regeneration generation of electrical energy based on the turning effort from a car drive network at the time of moderation of a car or braking while invention of claim 6 transmits driving force to the drive network of a car based on the power from a heavy current dc-battery, 2nd at least one dynamo-electric machine which generates electricity based on an engine output, In the hybrid car equipped with the control circuit which controls the regeneration generation of electrical energy by said 1st dynamo-electric machine, and the generation of electrical energy by the 2nd dynamo-electric machine according to the operational status of a car Said control circuit is responded to the power of a heavy current dc-battery which can be charged. The power concerned which can be charged When smaller than total with the regeneration generated output at the time of moderation by the 1st dynamo-electric machine, the regeneration generated output at the time of braking by the 1st dynamo-electric machine, and the generated output by the 2nd dynamo-electric machine, it constituted so that a heavy current dc-battery might be preferentially charged in order of said power.
[0015] Invention of claim 7 shall contain the power always consumed in a car in the power of a heavy current dc-battery which can be charged in invention of above-mentioned claim 6.
[0016]
[Function and Effect] According to above-mentioned claim 1 thru/or invention of 5, at the time of the power consumption of a DC to DC converter, and starting of the 2nd dynamo-electric machine, at the time of the power running of power consumption and the 1st dynamo-electric machine, the

output possible power of a heavy current dc-battery suppresses the supply voltage to the 1st dynamo-electric machine, at least when smaller than total with power consumption, and the power of a heavy current dc-battery is preferentially distributed to a DC to DC converter or the 2nd dynamo-electric machine. Therefore, the function of a hybrid car is certainly maintainable, being able to avoid the situation where the electric power supply of auxiliary machinery becomes impossible, or engine starting is overdue with transit by the driving force of the 1st dynamo-electric machine under the condition that the output possible electrical potential difference of a heavy current dc-battery is falling, namely, preventing the overdischarge of a heavy current dc-battery.
[0017] In invention of claim 2, when it has the 3rd dynamo-electric machine which supplies power required for actuation of a change gear in the above-mentioned invention, priority is given to the power consumption of this 3rd dynamo-electric machine over power consumption at least at the time of the power running of the 1st dynamo-electric machine. Therefore, in the car which actuation of a change gear takes power, normal actuation of a change gear can be secured as much as possible, and operability aggravation of a car can be prevented. Moreover, by the car which carried the belt type nonstep variable speed gear (CVT), for example as a change gear, in order to push the adjustable pulley of an infinitely variable device against a belt, oil pressure is used, and it becomes the configuration of driving the pump for this oil pressure generating with the 3rd dynamo-electric machine. In this case, if the electric power supplies to the 3rd dynamo-electric machine will run short, a slip will arise between a belt and an adjustable pulley, and normal power transfer will not be able to be performed, but wear of a change gear will also be promoted. According to this invention, generating of such fault is beforehand avoidable.
[0018] He is trying for the output possible power of the heavy current dc-battery at the time of the above-mentioned engine starting to forbid the drive of the 3rd dynamo-electric machine in invention of claim 3, at the time of the power consumption of a DC to DC converter, and starting of the 2nd dynamo-electric machine, when smaller than total with power consumption and the power consumption of the 3rd dynamo-electric machine until engine starting is completed. The fall of the power accompanying the hydraulic pressure supply to a change gear can be avoided under the conditions to which the output possible power of a heavy current dc-battery is falling by this, and the certainty of engine starting can be raised.
[0019] When the output possible power of a heavy current dc-battery is insufficient in the operational status from which transit driving force is obtained only by the 1st dynamo-electric machine, he drives the 2nd dynamo-electric machine with an engine, and is trying to generate power in invention of above-mentioned claim 1 in invention of claim 4. The operational status from which transit driving force is obtained only by the 1st dynamo-electric machine will be the transit conditions which must make a wheel generate driving force, without using an engine (where for a clutch to be cut), if it puts in another way, for example, in order to make slope start easy, while simulating the creep of a torque converter with the 1st dynamo-electric machine, it is the retreat transit time etc. Since an engine cannot be used as transit driving force at the time of such conditions, a car will become transit impossible, if since the output possible power of a heavy current dc-battery is insufficient to the power which the 1st dynamo-electric machine requires is said and the supply is controlled. Then, putting an engine into operation at the time of such a service condition, generating electricity with the 2nd dynamo-electric machine, and this securing power as much as possible, the 1st dynamo-electric machine is driven and transit can be made possible. Although it may be made to perform it from this dc-battery, the electric power supply to the 1st dynamo-electric machine at this time charging a heavy current dc-battery with the generating power of the 2nd dynamo-electric machine, it can raise the effectiveness of power use by supplying the generated output of the 2nd dynamo-electric machine to the 1st dynamo-electric machine directly, as shown as invention of claim 5.
[0020] Invention of claims 6 or 7 prevents overcharge of the heavy current dc-battery at the time of two or more 2nd dynamo-electric machines containing the 1st dynamo-electric machine or this performing a regeneration generation of electrical energy etc. That is, according to these invention, according to the power of a heavy current dc-battery which can be charged, when the power concerned which can be charged is smaller than total with the regeneration generated output at the time of moderation by the 1st dynamo-electric machine, the regeneration generated output at the

time of braking by the 1st dynamo-electric machine, and the generated output by the 2nd dynamo-electric machine, a heavy current dc-battery is preferentially charged in order of said power. In the regeneration generation of electrical energy at the time of moderation, the 1st dynamo-electric machine connected with the drive system at the time of car moderation is made to generate electricity, a heavy current dc-battery is charged, and the moderation engine performance equivalent to engine brake with an engine is secured by the generation-of-electrical-energy load at this time. Moreover, the regeneration generation of electrical energy at the time of braking is the case where the regeneration generation-of-electrical-energy actuation at the time of said moderation is accompanied by actuation of the damping device by the operator. The generation of electrical energy by the 2nd dynamo-electric machine is the case where it generates electricity by driving the 2nd dynamo-electric machine by operation of an engine.

[0021] According to this invention, under the conditions from which a heavy current dc-battery is likely to serve as excess of charge, the generation-of-electrical-energy actuation by the 2nd dynamo-electric machine is postponed, and priority is given to the opportunity of the regeneration generation of electrical energy by the 1st dynamo-electric machine which affects the feeling of moderation of a car. That is, prevention of overcharge of a heavy current dc-battery and reservation of the moderate moderation engine performance of a car can be aimed at, aiming at improvement in the energy efficiency by regeneration.

[0022] The power with which invention of claim 7 contains the power always consumed in a car as power of a heavy current dc-battery which can be charged in invention of above-mentioned claim 6 is set up. The power always consumed is the power consumption of the 3rd dynamo-electric machine for operating the change gear mentioned above, for example. Thus, the optimal control of electric power which agreed according to the actual condition of the power consumption of a car becomes possible by considering the power always consumed and setting up the power which can be charged.

[0023]

[Embodiment of the Invention] The operation gestalt of this invention is explained based on a drawing below. The example of a configuration of the hybrid car which can apply the invention in this application to drawing 1 - drawing 2 first is shown. This is the hybrid car of the parallel method it runs using the power of either an engine or a motor and both sides according to transit conditions. In drawing 1 , a thick continuous line shows the transfer path of mechanical power, and a thick broken line shows the power line. Moreover, a thin continuous line shows the control line and the double line shows a hydraulic system. The power train of this car consists of a motor 1 (the 2nd dynamo-electric machine of this invention), an engine 2, a clutch 3, a motor 4 (the 1st dynamo-electric machine of this invention), a nonstep variable speed gear 5, a reduction gear 6, a differential gear 7, and a driving wheel 8. The output shaft of a motor 1, the output shaft of an engine 2, and the input shaft of a clutch 3 are connected mutually. The motor 1 and the engine 2 are connected possible [a mutual drive] through the reduction gear (not shown) which has a predetermined speed ratio. Moreover, the output shaft of a clutch 3, the output shaft of a motor 4, and the input shaft of a nonstep variable speed gear 5 are connected mutually.

[0024] An engine 2 and a motor 4 serve as a source of promotion of a car at the time of clutch 3 conclusion, and only a motor 4 serves as a source of promotion of a car at the time of clutch 3 release. The driving force of an engine 2 or a motor 4 is transmitted to a driving wheel 8 through a nonstep variable speed gear 5, a reduction gear 6, and a differential gear 7. A pressure oil is supplied to a nonstep variable speed gear 5 from a hydraulic power unit 9, and the clamp and lubrication of a belt are made.

[0025] A motor 1 is mainly used for engine starting and a generation of electrical energy, and a motor 4 is mainly used for regeneration operation at the time of the power running of a car, and moderation. Moreover, a motor 10 is an object for the oil-pump drive of a hydraulic power unit 9. However, a motor 1 can also be used for the power running of a car, and braking at the time of clutch 3 conclusion, and a motor 4 can also be used for engine starting or a generation of electrical energy. A clutch 3 is a powder clutch and can adjust transfer torque.

[0026] Motors 1, 4, and 10 are driven with inverters 11, 12, and 13, respectively. In addition, in using a direct-current electric motor for motors 1, 4, and 10, it uses a DC to DC converter instead of an inverter. It connects with the heavy current dc-battery 15 through the common DC link 14, and

inverters 11-13 change the alternating current generated output of motors 1 and 4 into direct current power, and charge the heavy current dc-battery 15 while they change the direct current power of the heavy current dc-battery 15 into alternating current power and supply it to motors 1, 4, and 10. In addition, since the inverters 11-13 of each other are connected through the DC link 14, the power generated by the motor under regeneration operation can be directly supplied to the motor under power running, without minding the heavy current dc-battery 15. 19 is a DC to DC converter for weak electric current, and reduces the high voltage of the heavy current dc-battery 15 even on the electrical potential difference suitable for electric system which operates by the low battery comparatively, such as an engine ignition and a control-system drive power source.

[0027] 16 is the controller equipped with the function of the control circuit of this invention, is equipped with a microcomputer, its circumference component, various actuators, etc., and controls the transfer torque of a clutch 3, the engine speed of motors 1, 4, and 10 and an output torque, the change gear ratio of a nonstep variable speed gear 5, the fuel oil consumption and fuel injection timing of an engine 2, ignition timing, etc.

[0028] As shown in drawing 2 , a key switch 20, the selection lever switch 21, the accelerator pedal sensor 22, the brake switch 23, a speed sensor 24, the dc-battery temperature sensor 25, dc-battery SOC detection equipment 26, an engine speed sensor 27, the throttle opening sensor 28, and a coolant temperature sensor 29 are connected to a controller 16. According to the setting location of the select lever (not shown) switched to which range of Parking P, neutral N, Reverse R, and drive D, one switch of P, N, R, and D turns on the selection lever switch 21.

[0029] The accelerator pedal sensor 22 detects the amount of treading in of an accelerator pedal, and the brake switch 23 detects the treading-in condition of a brake pedal. A speed sensor 24 detects the travel speed of a car, and the dc-battery temperature sensor 25 detects the temperature of the heavy current dc-battery 15. Dc-battery SOC detection equipment 26 detects SOC (State Of Charge) which is the central value of the net volume of the heavy current dc-battery 15. Moreover, an engine speed sensor 27 detects the engine speed of an engine 2, and the throttle opening sensor 28 detects the throttle-valve opening of an engine 2. A coolant temperature sensor 29 detects the cooling water temperature of an engine 2.

[0030] The fuel injection equipment 30 of an engine 2, an ignition 31, the good fluctuation valve gear 32, etc. are further connected to a controller 16. A controller 16 drives an ignition 31 and performs ignition timing control of an engine 2 while it controls a fuel injection equipment 30 and adjusts supply, a halt, and fuel oil consumption and fuel injection timing of the fuel to an engine 2. Moreover, a controller 16 controls the good fluctuation valve gear 32, and adjusts the operating state of the intake/exhaust valve of an engine 2. In addition, a power source is supplied to a controller 16 from the low-pressure auxiliary dc-battery 33. The auxiliary dc-battery 33 is charged with the output from DC to DC converter 19 mentioned above.

[0031] The above shows the fundamental example of a configuration of the hybrid car which can apply this invention, and aims at controlling optimally the power allocation for power running or a regeneration generation of electrical energy by this invention according to each part power situation of such a hybrid car. It explains referring to each drawing below drawing 3 per operation gestalt of the contents of control of the controller 16 for it below.

[0032] The flow chart in which drawing 3 thru/or drawing 5 show the outline of control of a controller 16, and drawing 6 are the logical-block Fig., and show the example of control in the case of mainly managing power allocation at the time of power running corresponding to the contents of above-mentioned claims 1-5. Processing expressed by these drawings is periodically performed by interruption processing etc. as what constitutes a part of synthetic control of the hybrid car by the controller 16. Hereafter, it explains along a flow chart.

[0033] In drawing 3 , while detecting an operational status signal at the beginning of this control based on the various sensors mentioned above or the signal from a switch and calculating power consumption WB and the power consumption WC of a motor 10 from this detection result at the time of the power consumption WA of a motor 4, and starting of a motor 1, the power consumption WD of DC to DC converter 19 is detected (steps 301-305).

[0034] The power consumption WA of a motor 4 is computed from the real torque (estimate), the power loss, and the rotational frequency of a motor 4 at the time of power running. In addition, since

the motor 4 is connected to a car drive system, it can ask for a rotational frequency from the signal of a speed sensor 24. Moreover, since the power consumption of a motor 4 becomes settled according to a demand of the operator at that time fundamentally, based on the output of the accelerator pedal sensor 22 etc., it is also computable.
[0035] Since it increases remarkably by engine internal friction at the time between the colds, it creates the map which makes cooling water temperature a parameter preferably, and although it can be considered in the state of warming-up completion that the power consumption WB at the time of engine starting by the motor 1 is about 1 constant value, it plans it so that it may set up by referring to this map.
[0036] The power consumption WC of a motor 10 is computed from a rotational frequency, real torque, and power loss like WA, or sets up a fixed value experimentally. Moreover, the power consumption WD of DC to DC converter 19 is directly calculated from the output current value, or sets up a fixed value experimentally.
[0037] Next, the output possible power WV of the heavy current dc-battery 15 is found (step 306). It asks for this based on the SOC value from the dc-battery SOC detection equipment 26 mentioned above.
[0038] Thus, after finding the output possible power WV of power consumption WA-WD of each part, and the heavy current dc-battery 15, power which can be consumed is managed by processing shown in drawing 4 .
[0039] In processing of drawing 4 , since the total value W0 and the output possible power WV of each above-mentioned power consumption WA-WD are measured first, and sufficient power for the heavy current dc-battery 15 will be secured if it is WV>=W0, processing of the following control of electric power is bypassed (step 401). On the other hand, at the time of WV<W0, ****** under the condition for which the car needs creep torque or the torque for retreat transit next is judged (step 402). This has for example, a change gear select lever in which transit range, and judges the time of the creep torque demand and the change gear being operated by the reverse range in the time (a clutch 3 being cut and the power transfer to a drive system from an engine 2 being intercepted at this time) of the accelerator pedal not being stepped on to be the time of retreat transit. Though the output possible power of the heavy current dc-battery 15 is insufficient under such conditions, since it is necessary to make a motor 4 generate the torque for power running, the power for power running has been secured by driving a motor 1 with an engine 2 and making generation-of-electrical-energy actuation perform (step 403).
[0040] When it is not a creep or the conditions of retreat, the electric power supply to a motor 4 is controlled (step 404), and then the comparison with the total value W1 of other power consumption WB-WD and the output possible power WV except the power consumption WA of a motor 4 is performed (step 405). Since control of the electric power supply about except motor 4 is unnecessary if it is WV>=W1 in this comparison, the following processings are bypassed. On the other hand, at the time of WV<W1, ****** at the time of engine starting is judged next. Since this is inconvenient if engine starting is not smoothly performed at the time of operation initiation of a car, it is for supplying power to the motor 1 for [as exceptional possible] engine starting irrespective of lack of the dc-battery output possible power WV under these conditions. While forbidding transit of a car at the time of starting, specifically, power is supplied to a motor 1 until an engine 2 carries out starting high-order detonation after forbidding actuation of the motor 10 which supplies oil pressure to the change gear 5 and holding down power consumption as shown in drawing 5 (steps 502-503). When an engine 2 carries out starting high-order detonation, while ending the electric power supply to a motor 1, the electric power supply to a motor 10 is permitted, and actuation of the change gear 5 after engine starting is enabled (step 504).
[0041] When it is not under the conditions of WV<W1 at the starting time, when the above-mentioned starting processing is ended, the electric power supply to a motor 1 is controlled (step 408), and the total value W2 of the power consumption WD of a motor 10 and the power consumption WD of DC to DC converter 19 is compared with the output possible power WV below (step 409). When it is WV>=W2 in this comparison, the above power control mentioned above is not performed, but to this, when it is WV<W2, the electric power supply to a motor 10 is controlled (step 410). Since optimal power allocation can be performed according to a high power demand of

the priority in a hybrid car, preventing the overdischarge of the heavy current dc-battery 15 based on such control of electric power, when dc-battery capacity declines, the expected function of a car can be maintained as much as possible.

[0042] The second operation gestalt is shown in drawing 7 thru/or drawing 9 . Similarly the flow chart in which drawing 7 and 8 show the contents of control, and drawing 9 are logical-block Figs. This shows the example of control in the case of managing charge power at the time of regeneration operation corresponding to the contents of above-mentioned claim 6 and invention of seven. In this control, as shown in drawing 7 , after detecting an operational status signal first, it judges whether a car is in a moderation condition (steps 701 and 702). Based on the signal from a speed sensor 24 and the accelerator pedal sensor 22, the vehicle speed is above to some extent, and a moderation condition is judged from not getting into the accelerator pedal. Since a regeneration generation of electrical energy is not performed when it is not in a moderation condition, the following processings are bypassed. When it judges with a moderation condition, while finding next the power WH of the heavy current dc-battery 15 which can be charged from SOC, the generating power WE at the time of the regeneration of a motor 1 is found. In addition, since a motor 1 is a configuration rotated with an engine 2, a regeneration generation of electrical energy is not performed at the time of the transit conditions by which the engine 2 is separated from the drive system, but WE serves as zero. Moreover, you may make it include the drive power of the motor 10 consumed in always, and the power consumption of DC to DC converter 19 in said power WH which can be charged.

[0043] Next, it judges whether it is at the moderation time accompanied by actuation of the damping device by the operator from the signal of the brake switch 23 (step 705), and the regeneration power WF and WG by the motor 4 is found according to the existence of this braking actuation, respectively (steps 706 and 707). In addition, it can also be called for with the magnitude of the internal pressure of the brake master cylinder outside drawing whether it is at the moderation time.

[0044] Thus, after calculating each regeneration power value, as shown in drawing 8 , total W3 and the power WH which can be charged of each above-mentioned power value WE-WG are measured. Since the heavy current dc-battery 15 can fully afford to charge if it is WH>=W3 at this time, control of a regeneration generation of electrical energy is not performed (step 801). On the other hand, at the time of WH<W3, the regeneration generated output WE by the motor 1 when the engine drive is carried out first is controlled (step 802).

[0045] Next, the total value W4 of other regeneration power WF and WG except WE is regarded as there being allowances in the power of the heavy current dc-battery 15 to a regeneration generation of electrical energy in this condition which can be charged, if it is WH>=W4 as compared with the power WH which can be charged, and the following processings are bypassed (step 803). On the other hand, at the time of WH<W4, the regeneration power WG by the motor 4 when next being accompanied by braking actuation is controlled (step 804). Furthermore the regeneration power WF and the power WH which can be charged by the motor 4 at the time of moderation without braking actuation are measured, and if it is WH>=WF and is a detour and WH<WF about the following processings, the regeneration power WF will be controlled (steps 805 and 806).

[0046] Since the opportunity of a regeneration generation of electrical energy according [the opportunity of the regeneration generation of electrical energy by the motor 1 at the time of braking] to the motor 1 at the time of moderation will be further secured from the regeneration generation of electrical energy by the motor 1 as much as possible rather than this by management of the above-mentioned regeneration generation of electrical energy Good performance is securable, being able to give the engine brake effectiveness at the time of moderation without the braking actuation especially concerned with the operation feeling at the time of car moderation greatly as much as possible by regeneration generation of electrical energy of a motor 1, namely, preventing the overcharge over the heavy current dc-battery 15.

[Translation done.]

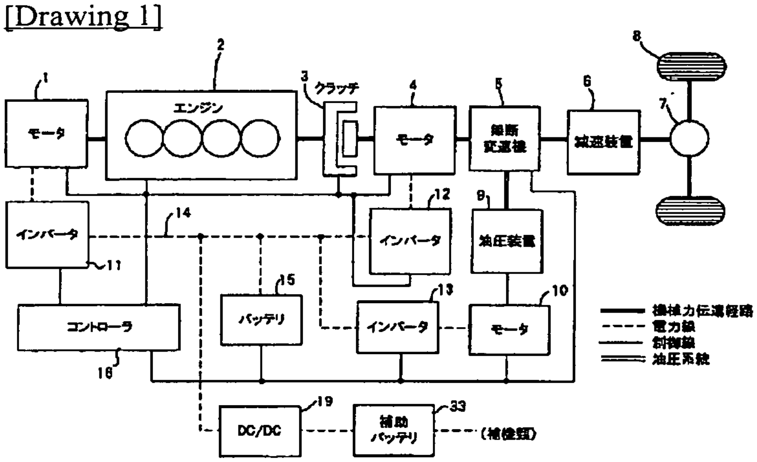
DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] **
[Drawing 2] The outline block diagram showing the example of a configuration of the hybrid car which can apply this invention.
[Drawing 3] **
[Drawing 4] **
[Drawing 5] The flow chart showing the outline of the first operation gestalt of control by the control circuit of this invention.
[Drawing 6] The logical-block Fig. of the operation gestalt of the above first.
[Drawing 7] **
[Drawing 8] The flow chart showing the outline of the second operation gestalt of control by the control circuit of this invention.
[Drawing 9] The logical-block Fig. of the operation gestalt of the above second.
[Description of Notations]
1 Motor (2nd Dynamo-electric Machine)
2 Engine
3 Clutch
4 Motor (1st Dynamo-electric Machine)
5 Nonstep Variable Speed Gear
9 Hydraulic Power Unit
10 Motor for Oil Pressure Generating
15 Dc-battery
16 Controller
19 DC to DC Converter
20 Key Switch
21 Selection Lever Switch
22 Accelerator Pedal Sensor
23 Brake Switch
24 Speed Sensor
25 Dc-battery Temperature Sensor
26 Dc-battery SOC Detection Equipment
27 Engine Speed Sensor
28 Throttle Opening Sensor
29 Coolant Temperature Sensor
33 Auxiliary Dc-battery

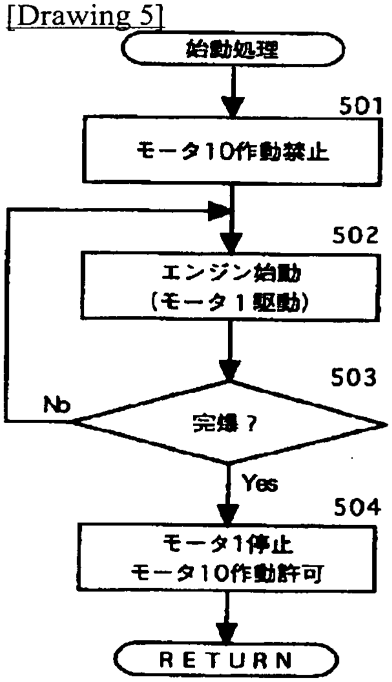
[Translation done.]

DRAWINGS

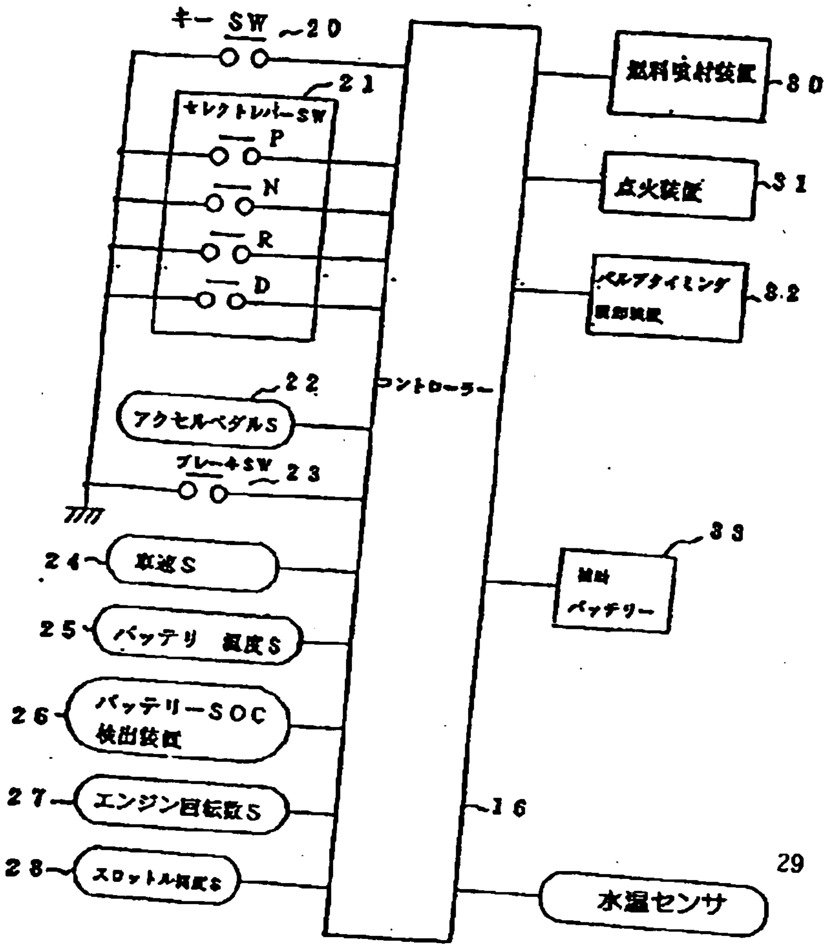
[Drawing 1]



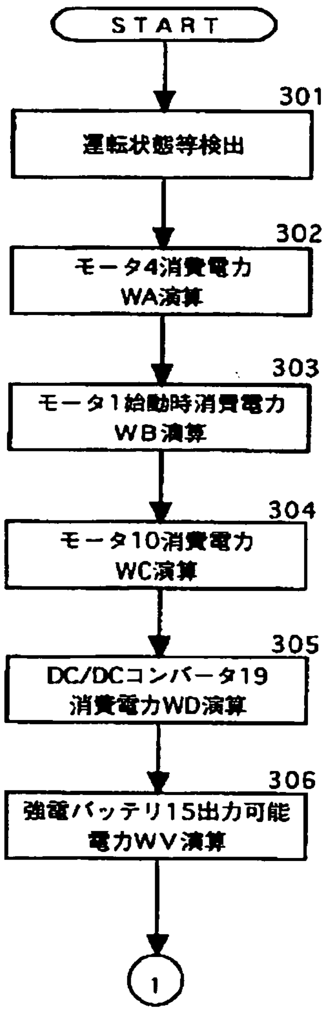
[Drawing 5]



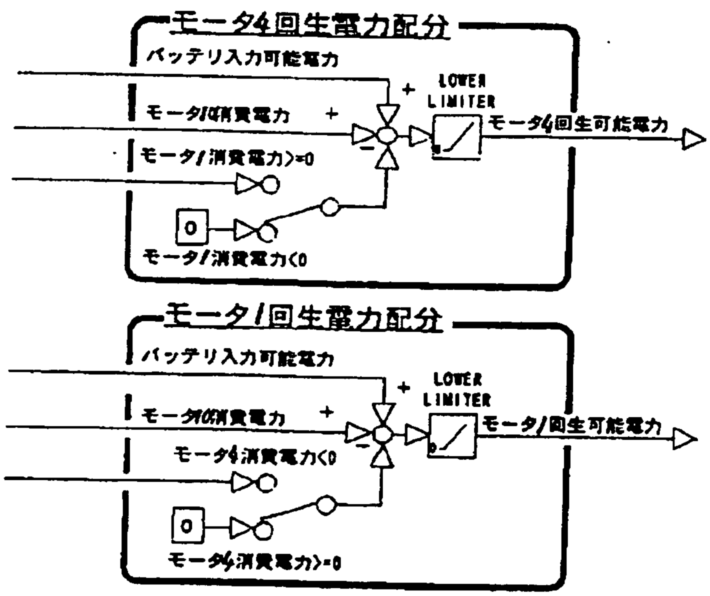
[Drawing 2]


キー SW 20
セレクトレバーSW 21
P
N
R
D
コントローラー
16
アクセルペダルS 22
ブレーキSW 23
24
25 バッテリ S
26 バッテリーSOC 検出装置
27 エンジン回転数S
28 スロットル
30
点火装置 31
バルブタイミング 32
33 バッテリー
水温センサ 29

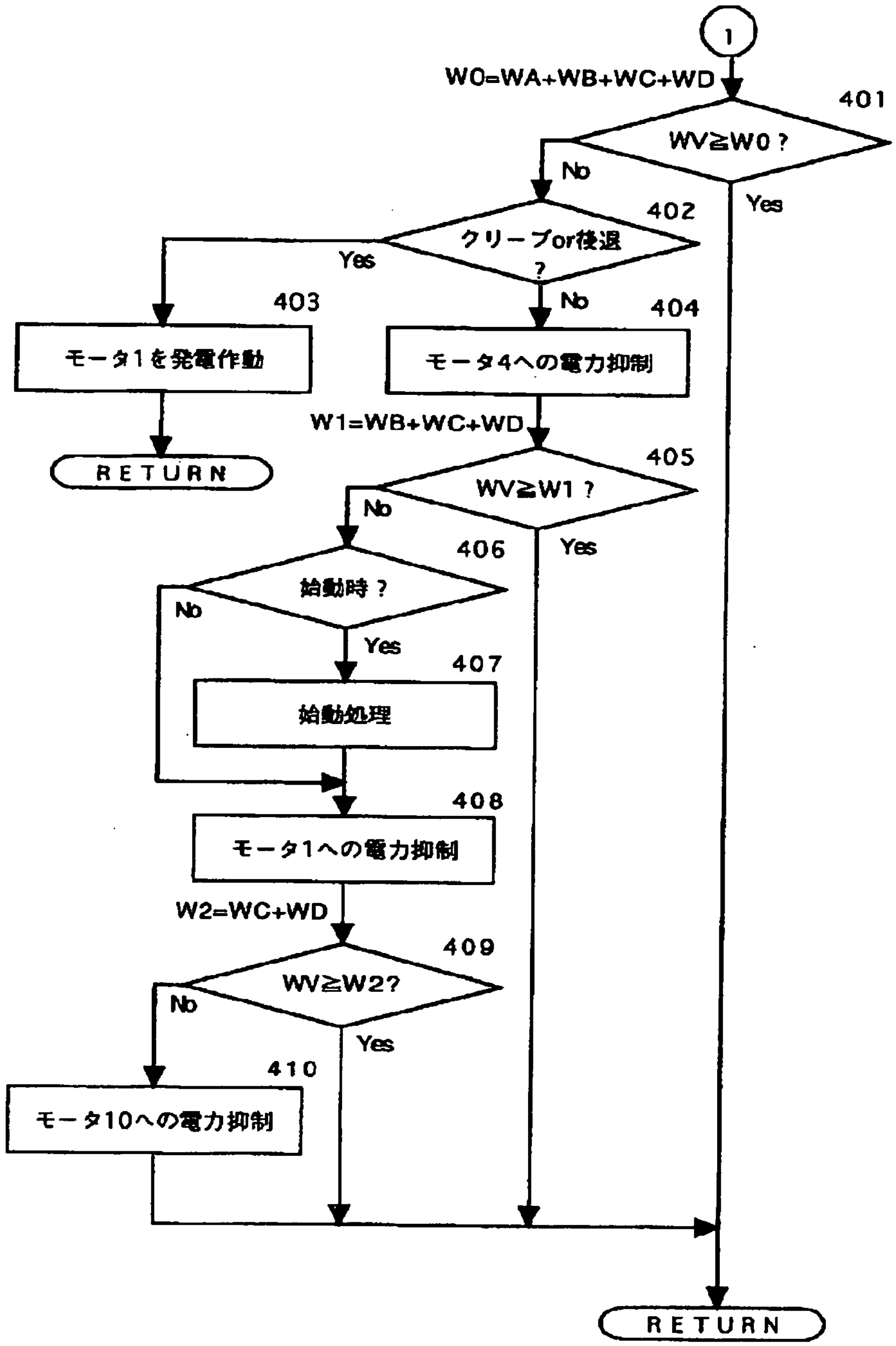
[Drawing 3]



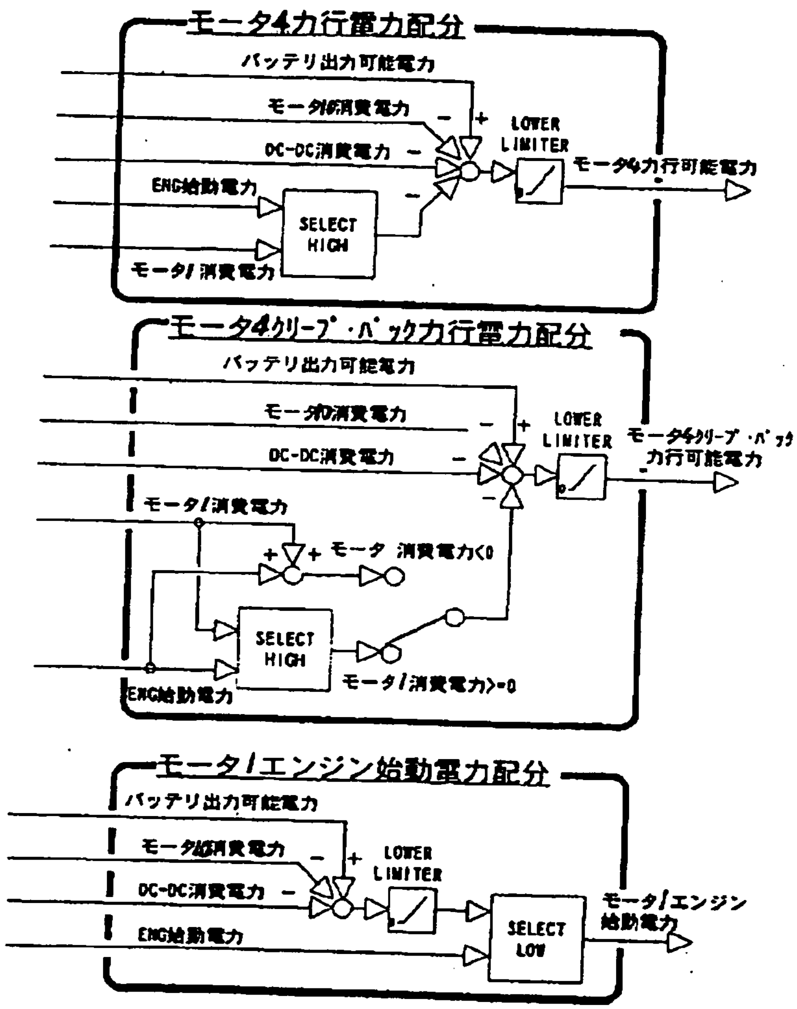
[Drawing 9]



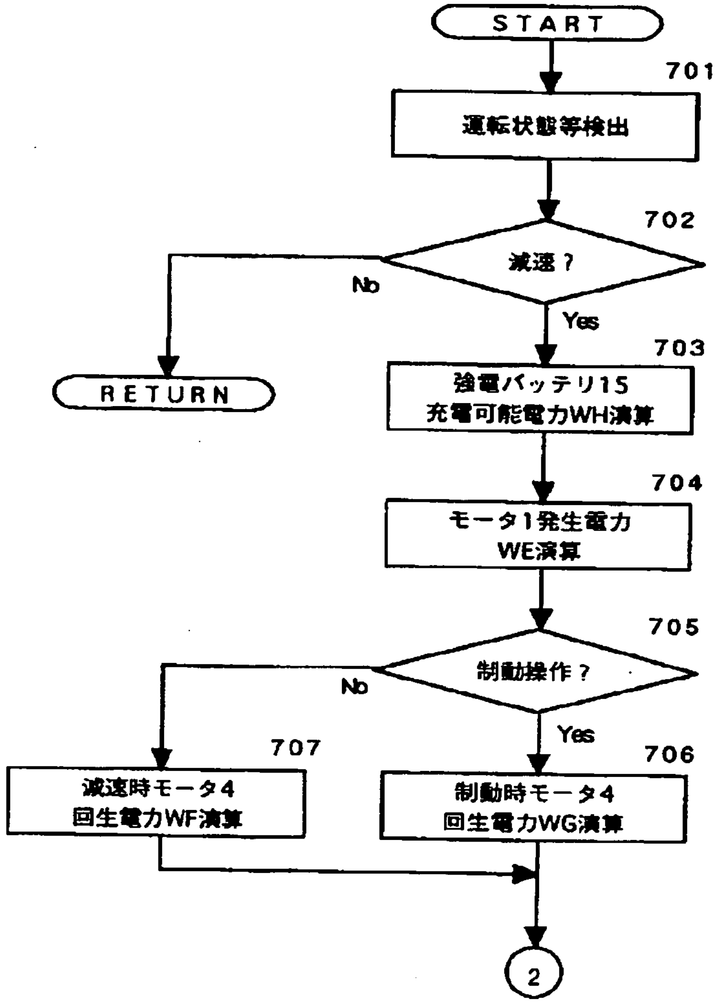
[Drawing 4]


1
W0=WA+WB+WC+WD
401
WV≧W0 ?
No
Yes
402
クリープor後退 ?
Yes
No
403
モータ1を発電作動
404
モータ4への電力抑制
RETURN
W1=WB+WC+WD
405
WV≧W1 ?
No
Yes
406
始動時 ?
No
Yes
407
始動処理
408
モータ1への電力抑制
W2=WC+WD
409
WV≧W2?
No
Yes
410
モータ10への電力抑制
RETURN

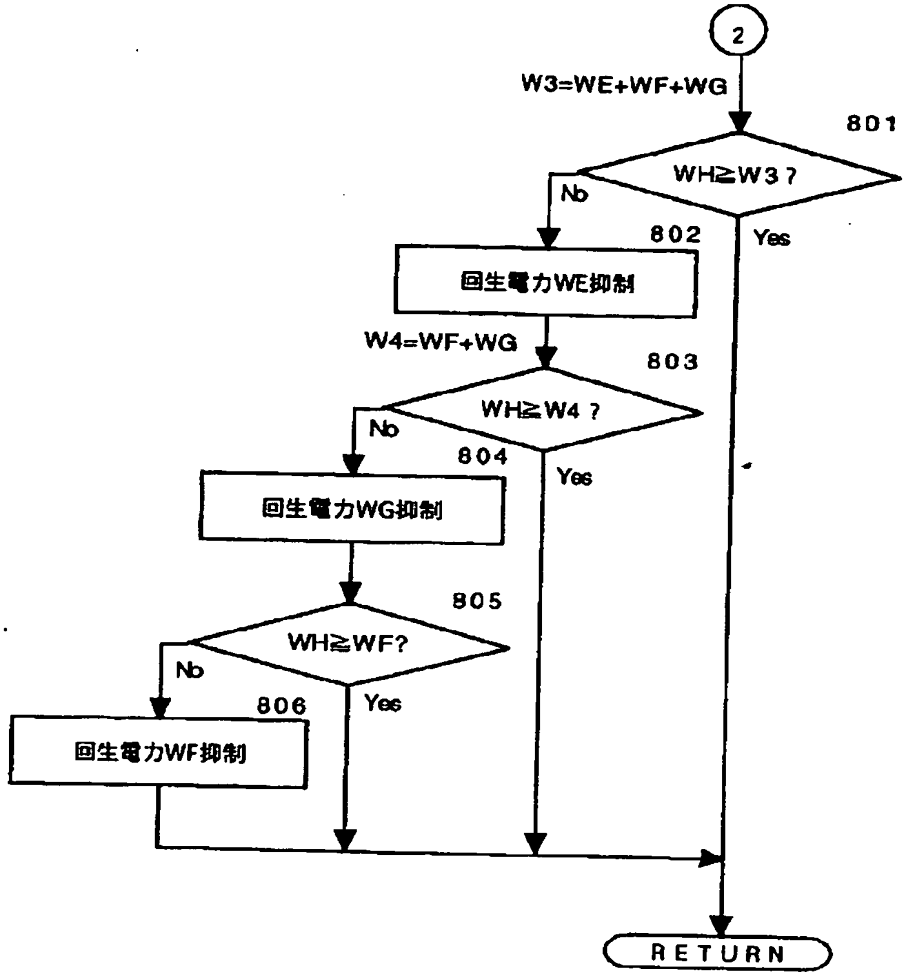
[Drawing 6]


モータ4力行電力配分
バッテリ出力可能電力
DC-DC消費電力
ENG始動電力
SELECT HIGH
モータ/ 消費電力
LOWER LIMITER
モータ4力行可能電力
モータ4クリープ・バック力行電力配分
バッテリ出力可能電力
DC-DC消費電力
モータ/消費電力
モータ 消費電力<0
SELECT HIGH
モータ/消費電力>=0
ENG始動電力
LOWER LIMITER
モータ4クリープ・バック力行可能電力
モータ/エンジン始動電力配分
バッテリ出力可能電力
DC-DC消費電力
ENG始動電力
LOWER LIMITER
SELECT LOW
モータ/エンジン始動電力

[Drawing 7]


START
701
運転状態等検出
702
減速？
No
Yes
RETURN
703
強電バッテリ15
充電可能電力WH演算
704
モータ1発生電力
WE演算
705
制動操作？
No
Yes
707
減速時モータ4
回生電力WF演算
706
制動時モータ4
回生電力WG演算
2

[Drawing 8]



[Translation done.]